(12) UK Patent Application (19) GB (11) 2 320 389 (13) A

(43) Date of A Publication 17.06.1998

(21) Application No 9725832.1

(22) Date of Filing 05.12.1997

(30) Priority Data
(31) 9626004 (32) 12.12.1996 (33) GB
9700079 13.01.1997

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(51) INT CL[6]
H04N 7/18 , G08B 13/196 , H04N 5/77

(52) UK CL (Edition P)
H4F FAAE FD12M FD12X FD24 FD30T3 FD83B FKX

(56) Documents Cited
GB 2295065 A GB 2231753 A US 5402167 A
US 4897732 A

(58) Field of Search
UK CL (Edition P) H4F FAAE FAAX FCK FKA FKX
INT CL[6] G08B 13/196 , H04N 5/77 5/907 7/18

(54) Video camera recorder which records via a buffer store so that video data generated before the recorder is switched on is recorded

(57) A video camera recorder is provided with "hind-sight" by locating a buffer store between the camera pick-up (eg a CCD) and the recording device. The buffer comprises a RAM configured to operate as a FIFO buffer and is interposed between the input and the recording sections of a camcorder. The action of the buffer is to delay (eg for 10 seconds) the recording of the audio and video data to the recording medium for a period of time at least equal to the period between the operator triggering the recording control and the data being registered on to the recording medium. Prior to recording the buffer merely overflows. The arrangement may be used for time lase and slow motion video effects by using the buffer as a time shifter. The recorder may be used for surveillance enabling images before an event to be recorded, for car security and as an electronic still camera. Single frames or multiple frames may be stored for later retrieval on to the main recording medium. The data may be monitored as it flows through the buffer.

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Video recording device

This invention relates to a video recording device.

Description

In the following description we will refer to the video recording device as **Hindsight** This also has an optional ability within the software to record and save images at either slowed down or speeded up time intervals. This will be referred to as **Time Shifter option.**

A brief description of Hindsight

The device - **Hindsight** - is a system that records and stores video and sound information before the camera is switched into its normal recording mode in either a normal, compressed or stretched time scale to real time.

Overview of Hindsight

In normal operating conditions that prevail (whether in the professional or amateur domain) a camera is powered up and switched on to view a scene prior to recording it. However in many cases the action suddenly starts before the camera operator anticipates or has time to switch the camera to record mode. If the camera is in 'save condition' it can take a further 2-3 seconds to lace up the camera prior to being able to record the information. Even in 'Standby Mode' slow reactions can loose valuable seconds of unrepeatable action. Even if the camera is a disc based recording machine the reaction time can still be half a second to press the Record Start button. More often than not action has already taken place and the camera operator and or director wishes that he could have started earlier. The device - **Hindsight** - will allow this wish to become a reality, not only for the 2-3 seconds lace up time but also the previous several seconds prior to the lace up time will be recorded as a lead into the action.

(Ten seconds is a realistic amount of time missed but in fact it could be thirty seconds or even one minute if enough memory were supplied.

Examples of practical use of the device - Hindsight

a) Wildlife videoing. A Predator is waiting to pounce. Often this can be minutes or even hours. As the action develops the camera is switched to record and the previous ten seconds are automatically recorded along with the real time events.

b) The expected action takes places earlier than anticipated. (The famous 'Ready when you are Mr. De Milne' syndrome when the action was missed)

c) The camera operator simply forgets to switch on until a function has started. (All is now retrievable including loss of face !)

d) If a director has a nervous actor, instead of shouting action he can quietly say 'Start when you are ready', knowing that when the actor eventually starts all will be captured.

The following document describes a single device which can store delayed images in real time as well as in time lapse & slow motion requirements using electronic techniques.

Hindsight can also be used for Time Lapse Photography ie **Time Shifter option.**

The concept of time lapse photography on film has long been a useful tool in the hands of creative cameramen. It has both artistic and scientific applications as it allows events which have taken place over minutes, hours and even months and years to be viewed in a matter of seconds.

The foregoing is achieved simply by exposing single frames of 'cine' film with suitable intervals between exposures. When the resulting film is replayed at a normal frame rate (25FPS) - time is effectively speeded up.

Example

A flower opening. The real elapsed time frame may be several days or weeks. Time lapse photography condenses this time frame down to several seconds

Hindsight can also be used for Slow motion photography ie **Time Shifter option**

The concept of slow motion photography on film has long been a useful tool in the hands of a creative cameraman. It has both artistic and scientific applications as it allows events which take place in a very small period of time to be viewed over an extended time period. The method of achieving this result is to pass the film through the cine camera at a high speed and then replay it at a lower frame rate.

Example:-

2) A car crash. The real elapsed time frame may last fractions of a second. Slow motion photography stretches this time frame back to several seconds.

With conventional cine film both of these effects (Time lapse and Slow Motion) are achieved by variations of the existing largely mechanical technology. Various factors limit the performance, particularly of slow motion cinematography where filming events which occur in fractions of a second requires significant outlay.

video Time lapse appraisal

A Video recorder is far from ideal for time lapse photography because essentially it a 'Real Time' recording process where the video heads and tape are revolving at a constant speed, in fact recording can not take place until the required speeds have been achieved.

Time lapse can be achieved by starting and stopping the recording each time an exposure is required. The minimum gap between exposures is then determined by the time period between the start and stop time of the video recorder. This is both time consuming and expensive on wear and tear of machinery. Similarly the same effect could have been achieved by extracting single frames of continuously recorded video tape. This method, whilst allowing a simpler recording technique, is limited to what can be recorded on a single reel of tape.

Slow motion systems have been engineered to enable the tape to run much faster than normal but ultimately there is a limit to the amount of data that can be transferred to the recording medium.

Combining Hindsight & Time Shifter option

Both these techniques use the concept of a stored buffer prior to downloading onto the main recording mechanism. Whereas the advantage in 'combination' with Time lapse photography is marginal, the advantage using Slow Motion photography is much as the chances of missing the action in a compressed time frame are greatly magnified.

E.g. In a wildlife sequence you may decide to shoot a Cheetah kill in slow motion. (Remember when getting this result using high frame 16 mm film it was easy to run out of film before the main action had happened and the film was wasted). Using a combination of Time Shifter in slow motion mode and Hindsight with its constant FIFO overflowing buffer, we could guarantee the shot because the only action necessary on the controls would be to switch to stop after the slow motion event had happened !

Technical description of Hindsight

The **Hindsight** device and its implementation is an solid state electronic unit which uses RAM (Random Access Memory) devices configured as a FIFO buffer, interposed between the input and recording sections of a camcorder. Its action is to delay the registering of the audio and video signals to the recording medium for a time period. The delay period is fixed and is designed to be of sufficient length of time to ensure that the **Hindsight** device fulfils its desired function. The minimum period is that which is required to cover the period between the operator triggering the recording control and valid data being registered on to the recording medium. Dependent on the intended application the optimum data storage, the period of time stored may be considerably greater.

Technical description of Time Shifter option

The Time Shifter device and its implementation is an solid state electronic unit which uses RAM (Random Access Memory) devices configured as a FIFO buffer, interposed between the input and recording sections of a camcorder. Its action in conjunction with suitable control circuitry is to store & delay the registering of video signals to the recording medium for a time period. The delay period is fixed and is designed to be of sufficient length of time to ensure that the Time Shifter device fulfils its desired function.

The minimum period is that which is required to cover the period between the recording part of the camcorder and valid data being registered on to the recording medium. Dependent on the intended application the optimum data storage, the period of time stored may be considerably greater.

Duration of Time Shifter option

The Time Shifter device with a 10 second RAM memory can store 250 frames. These can be captured either as single individual frames as in Time Lapse (less than 25 fps) or in the case of slow motion (more than 25fps). For purposes of this description we assume that standard video in PAL is replayed at 25 FPS therefore if the camcorder is fitted with a suitable solid state storage device capable of holding say 10 seconds of real time video data (when replayed at 25FPS) then dependent on whether these 250 frames of data were stored into memory over an extended or a foreshortened period of time the resulting viewed image would either be slowed down or speeded up.

Technical Summary of Hindsight

The device relies on **'DSAV'** for its operation. **DSAV** which (in this application stands for **'Digitally Stored Audio and Video')** is a method and a device which is capable of receiving an electronic signal (namely the data stream which emanates from the camera and microphone (input) portion of a video recorder), and storing it in a **FIFO** (First In, First Out) buffer before outputting the same data stream to the recording section of a video recorder.

Additional Advantages of Hindsight

Pre-start

Allows absolutely instant start feature to video recorder. Normally (in the 'Save' configuration) there is a few second lace up period during which time the tape stored inside the cassette is threaded around the recorder mechanism. During this time (and any additional time whilst the recording mechanism builds up to the correct speed), recording does not begin. However, if the length of stored data time exceeds the lace up time, then to all intents and purposes the recording will appear to have started even before the instant the record button is pressed.

Reducing head and tape wear

Many video recording systems have a pause facility whereby the forward motion of the tape is stopped whilst the recorder is in pause mode. The tape remains laced up and the drum carrying the record heads continues to revolve. Whilst many video recorders have the facility to be left in this pause mode indefinitely, most manufacturers advise against doing so as wear will take place on one point of the tape. In addition wear is still taking place on the recorder heads. Using the DSAV (Digitally Stored Audio and Video) device this will allow the tape to be unlaced and re-laced and the recorder mechanism left in an inactivated state.

The controls feature required for Time Shifter option

1) A shutter speed control ranging from 10 to 2000 or even 5000 fps

2) A trigger control to either start or end the data stream and hence to stop the FIFO buffer from loosing any information at the output end of the buffer when the required elapsed period has finished.

3) A timer clock ranging from 1 week to 1/500$^{th\ sec}$

4) A strobe control whereby it is possible to make a combination of the two - elapsed time duration followed by an amount of frames that are recorded after each time period. I.e. 5 second interval after which 10 frames are put down and then repeated as long as necessary. (*See non linear effects)

5) Fill or Flow control. This selects whether the buffer fills up and holds its maximum memory waiting to be downloaded or whether it allows the information to flow out at the end as new information replaces it. This would be particularly useful if an action event has not yet occurred but where the built up time prior to the event is still relevant. In the case of a repetitive sequence and with constant monitoring, all that is required to happen is that the buffer be stopped at the required moment and depending upon the before and after control setting, the relevant information will be stored waiting to be down loaded.

6) A Before and After delay control. This allows for a before & after delay. When it is desirable to see cause and effect the ten second buffer (real time in playback) can be split into two parts depending upon what part of the action is required to record. I.e. The action of a bullet striking a light bulb all happens in a fraction of a second. The cause (the bullet) has little interest until it strikes the glass envelope of the bulb, then the effect will be analysed. In this case the 10 second real time buffer holding the slowed down images would be set for one third prior to impact and two thirds afterwards.

NB There will be an overlap range which is not possible to select i.e. a slow shutter speed with a short elapsed time frame which amounts to a longer exposure than the

frequency of time between frames. The software programme will not allow this to be selected.

Advantages of the Time Shifter option device are:-

1) Consecutive individual frames may be stored that can be replayed without further selective editing.

2) The mechanical and electronic recording parts of the video recording mechanism are not constantly in use in the case of time lapse intervals and constant back space editing and in the case of slow motion the mechanical framework is not expected to run at a very high speed. Therefore there is a significant saving in wear and tear on both counts.

3) For time lapse the buffer allows any number of individual frames to be collected and downloaded onto tape which typically would be 30-40 minutes of real time duration on a current professional recording device or 60 - 240 minutes for a current domestic VHS recorder. Either way the real replay time far exceeds the requirements of any practical usage for which the time lapse period covers. In other words the Time Shifter can cover periods of time ranging from seconds to many months or even years.

4) The exposure interval in between frames can be as long as the interval between frames minus one 24th. of a second. In other words a time lapse that recorded one frame per second could have an exposure of 24/25 ths of a second which could be desirable for low light usage as the actual exposure period could be up to 24/25ths of a second. On the other hand a far higher shutter speed (such as 1/500 or 1/2000 Th. sec) could also be selected with the intention of making separate but fast moving images sharper. Similarly an elapsed duration of 10 seconds between frames could allow an exposure time of almost 10 seconds long.

5) Using the 'Before and After' control the cause and effect photography can be recorded. E.g. A bird of prey strikes a kill in slow motion. We can see the just before the kill and the effect immediately afterwards.

6) Using the fill and flow we can either fill up the buffer to a maximum amount then download it or if the required happening has not quite taken place we can shift the time frame by allowing some of the end information to flow off the end of the buffer.

7) Ultra high speed images can be slowed right down and again the before and after effect can be utilised to great advantage with the very short time span covered.

8) More than one buffer can be used each with a lens and camera but without several recording devices.

Monitoring - especially of time lapse in progress can take place.

How Time Shifter option works in practice

The device is programmed for either time lapse or slow motion. In the case of time lapse it is how many frames that are recorded at less than 25 per second. The time interval range should be from between 10 frames per second through to one week. Typically 10-5-3 fps - 1 per sec - 3-5-10-20-30-60 seconds -1-2-4-8 -12-24-48-72-168 hours

In the case of slow motion it is how many frames that are recorded at more than 25 per second. The time interval range should be from between 50 frames per second through to 1000 (or even 5000).

The buffer memory stores individual frames at pre-set intervals. Once the buffer approaches its full capacity, the recording device is programmed to make a back space edit then go into its record mode and the buffer is downloaded onto the tape or larger hard disc recording format. This leaves the buffer free to store more individual frames. Although in the case of slow motion video recording the buffer will take longer to download than the elapsed time frame which it recorded. In other words in the slow motion mode the timing for the start of the action is critical and can only be used as a one off until the information is downloaded. However two or more of these devices can be linked in series to extent the elapsed real time period which is to be covered.

Duration of Hindsight

It can be any duration (dependent upon memory capacity) and acts as a 'buffer' between the camera/lens objective and the recording device whether it be tape, disk or other method by which video and sound signals can be stored. Typically it could be of ten seconds duration as this would cover most purposes although it would not be limited to this time duration. If, after ten seconds duration, the main recording medium is not switched on, then the 'buffer' will overflow and earliest information will be lost and it will be continuously replaced by newer data.

Downloading Hindsight

At the end of the 'recording period' the system must keep running for a further 'ten seconds' to download the 'buffer' contents onto the recording medium.

Downloading Time Shifter option

The minimum duration that could utilise the Time Shifter would be defined by the maximum duration of the buffer memory and its ability to be downloaded before it stores newer images. E.g. If the intervals between pictures was one second and it took the camera 3 seconds to reach record speed, then a minimum memory of five seconds would be desirable.

With a one hour duration interval between frames the recording mechanism could be switched off and would only be required every three days to download ! This would be quite advantageous as it would mean that the main recorder would not need to be permanently on site.

Time Shifter option as Stand alone &/or Integral part of main recording device

The Time Shifter device can either be built into the main recording device as an optional extra or can be a separate stand alone device. The device can be operated without the main recording device being linked up. In this case a lens and CCD camera with video output into the device and battery are all that are required. One or more of these devices can be used to obtain different angles or different framing rates. Once the buffer is full it will need to be downloaded before being able to be used again to collect more data.

(Researching throughout the BBC we find that the normal time lapse duration of final shot is 30 seconds, even though the average duration of final shot used is 6-8 seconds. With the ability to monitor stored frames and thus progress and with the added ability to shift the 'before and after' effect, it will be easier to operate within a 10 second window. However the great advantage with this Time Shifter device is that this extended window is instantly attainable by downloading existing images and re-storing new ones. Even a multi camera shoot, utilising two or more Time Shifter devices used with a few second offset, to allow downloading time from individual buffers, would enable a built up of a longer than 10 seconds final shot to be attained.

However a 10 second window would suit 90% of applications.)

Monitoring Time Shifter option

All stored images are able to be accessed and viewed onto a monitor at any time during the acquisition period. This would require a separate set of monitoring controls.

Other possibilities using the Time Shifter device

Multi exposure images could be built up in the same way as photographic images on film. This would in effect be a series of still images with a series of different component parts that formed the final image.

Non Linear effects

The software with which to operate this buffer could be programmed to allow each frame to be outputted several times (*see controls). This would give the impression of time lapse but allowing each individual picture to be seen for a selected elapsed time period. In other words a time lapse sequence of one second duration (which is speeding up real time images by 25 times) could be replayed and downloaded as say five consecutive picture images. This would give the impression of strobed time lapse without any additional editing. Any permutation of repetitive frames could be programmed from this buffer. E.g. A plant growing over a two week period could be speeded up via time lapse but made more understandable by seeing bursts of real time action.

Variable shutter speeds

The software with which to operate this buffer could be programmed to allow each frame to be exposed for a longer period or shorter than normal.

Time Shifter option shutter speeds

A modern CCD camera has the option of a range of shutter speeds. These are normally from 1/50th second up to a 1/2000th. The Time Shifter option device could store these images at any of these shutter speeds depending upon the results desired.

Shutter Speed	Pictures stored per sec	Slow Motion Factor	Elapsed time span
1/50th	25	1 x	10 sec
1/100th	50	2 x	5 sec
1/200th	100	4 x	2.5 sec
1/250th	125	5 x	2 sec
1/500th	250	10 x	1 sec
1/1000th	500	20 x	0.5 sec
1/2000th	1000	40 x	0.25 sec
1/10000th	5000	200x	0.05 sec

The camera device

The 'camera and microphone' portion referred to above can be any devices capable of converting visual images and audible sounds to an electronic signal. Typical camera devices are CCD (Charged Coupled Device) cameras and capacitor microphones (although cathode ray tube cameras would benefit equally). Both these, together with their relevant interface circuitry, produce a signal which can be of analogue or digital nature which is then normally fed into the recording section of a camcorder.

The recording device

The recording section usually consists of a cassette tape transport mechanism at the heart of which is a helical scan drum system capable of registering magnetically on the recording medium (tape) the analogue or digital data generated by the input portion of the camcorder system.

When the camera is switched out of record mode but a further shot is required before the 10 second 'buffer' has been downloaded, then exactly the same conditions would apply - namely that the recorder would continue to receive information as it fell off the end of the 'buffer' and continue for 10 seconds after all recordings had stopped. (It would not be necessary to aim the camera at the subject after the decision had been taken to stop recording even though the recording was still downloading).

Hindsight Functionality.

The **Hindsight** device would ideally be build into and incorporated within a video recording system, however it could also be an external device that allowed information to be fed into it (where it was stored and delayed) and then onto the recording medium. If it was an optional extra then it would be desirable for the camera to be manufactured so as to enable this 'additional unit' to be plugged in between the camera/lens viewing device and the actual recording device. It may be that existing camcorders could be modified to incorporate the **Hindsight** device. The camcorder would have to have an outlet interface from the camera viewing side and have an inlet interface to the recording device. At all times the device is in use it operates in-between the camera/lens function and the recorder/recording mechanism. There would be no reason why the **Hindsight** device could not be either in use at all times or it could be switched out of the system.

Hindsight as a stand alone device

The Hindsight device does not need a separate recording outlet when the action can predictably take place within the time scan of its memory capacity. With a ten second 'buffer' that is constantly storing fresh information then all that is required to keep this information is that the device is switched off before the wanted information has been lost. The **Hindsight** device buffer can then be downloaded onto a tape or disc storage medium in the normal way at a later time. The advantages of this are practical and economic. In a predictable video recording location it is often desirable to have two or more cameras running at the time of the action. EG a car crash scene. Two such cameras with **Hindsight** buffers could be recording permanently along with the main video camera. A few seconds after the action has stopped the two extra cameras are switched off. Their image and sound information is then downloaded onto the main camera and they are ready to be used again. This saves having three of the more expensive recording machines and keeps the quality of recording consistently the same for all three.

Hindsight Quality

The process of storing and retrieving the data in the **Hindsight** device should be such that no loss of quality of the video or audio data is perceivable and ideally data transfer rates and data bandwidth should equal or better the specification of the original system. A professional camera such as a Sony DVW700P, which stores information at the rate of 125.58 M/bits/Sec, would require higher quality and more memory and processing than an amateur domestic VHS type camera.

Hindsight as a Surveillance camera

Typically Surveillance cameras take single frames or bursts of frames at intervals and these are stored onto a low quality recording medium. If the **Hindsight** device were utilised then the lead up to the moment of required surveillance could be stored and downloaded in the same way as described previously. Real time images rather than time lapsed would be more useful in identifying a crime. The only difference being that

some form of triggering mechanism such as a broken beam, an emergency switch, a trembler device or sound activated switch must be operated to save the previously stored images.

Hindsight as a car security camera

With a **Hindsight** device incorporated within a car, each new driver would be recorded and stored for a few seconds after which time the 'buffer' would run continuously. If the driver was unauthorised then his image would be retrievable once the car was recovered. Perhaps the most important use would be in the event of a crash. The **Hindsight** device, running continuously, would be de-activated in the event of one of the cars sensors detecting a crash and stop immediately. The device would be built into an inaccessible part of the vehicle that was fireproof and tamperproof. The recording would legally belong to the owner of the car and could be presented in evidence on his behalf in any analysis of the accident.

Hindsight as a stills Cameras

The same principal would apply to stills cameras as moving image cameras. Once the camera is switched on and the **Hindsight** device activated then images at a pre determined rate are being constantly stored into the memory. Until the camera shutter control is activated the information is lost after say 10 seconds. However as a still photo requires higher quality than a video frame, then more memory would be required. However if a frame rate of say 3 pictures per second were selected, then this would make the memory more desirable in size and economics. Once images were stored they should be reviewed and only ones capturing the required action need to be kept, thus releasing the rest of the memory for future use. For still photographs this 3 second frame rate would be very desirable as most motor drives operate at about this speed. If a higher rate was required (say 5 frames per second) then this could be selected but less elapsed time would be available as stored pictures in memory. I.e. the window of information would be less, the more images were stored for a given memory capacity.

Framing rates and memory

For a given memory capacity there would be a number of photographs stored at a given file size. Let us say this is 15 images to be held in temporary memory.

Frames per second	Elapsed time covered (in seconds)
1	15
3	5
5	3
10	1.5
15	1

Claims

1) **The Hindsight Device** comprises a solid state electronic memory unit which uses RAM (Random Access Memory) devices configured as a FIFO buffer, interposed between the input and recording sections of a camcorder. Its action is to delay the registering of the audio and video signals to the recording medium for a time period. The delay period is fixed and is designed to be of sufficient length of time to ensure that the device fulfils its desired function. The minimum period is that which is required to cover the period between the operator triggering the recording control and valid data being registered on to the recording medium. Dependent on the intended application the optimum data storage, the period of time stored may be considerably greater.

2) **The Hindsight Device** as claimed in 1 relies on **'DSAV'** for its operation. **DSAV** which (in this application stands for **'Digitally Stored Audio and Video')** is a method and a device which is capable of receiving an electronic signal (namely the data stream which emanates from the camera and microphone (input) portion of a video recorder), and storing it in a **FIFO** (First In, First Out) buffer before outputting the same data stream to the recording section of a video recorder.

3) **The Hindsight Device** as claimed in 1 & 2 can be any duration (dependent upon memory capacity) and acts as a 'buffer' between the camera/lens objective and the recording device whether it be tape, disk or other method by which video and sound signals can be stored. Typically it could be of ten seconds duration as this would cover most purposes although it would not be limited to this time duration. If, after ten seconds duration, the main recording medium is not switched on, then the 'buffer' will overflow and earliest information will be lost and it will be continuously replaced by newer data.

4) **The Hindsight Device** as claimed in 1,2 & 3 can be downloaded at the end of the 'recording period' so long as the system is keep running for a further 'ten seconds' in order to download the 'buffer' contents onto the recording medium.

5) **The Hindsight Device** as claimed in 1,2,3,4 can be used with any 'camera and microphone' portion referred to in the description which act as any devices capable of converting visual images and audible sounds to an electronic signal. Typical camera devices are CCD (Charged Coupled Device) cameras and capacitor microphones (although cathode ray tube cameras would benefit equally). Both these, together with their relevant interface circuitry, produce a signal which can be of analogue or digital nature which is then normally fed into the recording section of a camcorder.

6) **The Hindsight Device** as claimed in 1 & 5 can be used to download onto any recording section which usually consists of a cassette tape transport mechanism at the heart of which is a helical scan drum system capable of registering magnetically on the recording medium (tape) the analogue or digital data generated by the input portion of the camcorder system.

7) **The Hindsight Device** as claimed in any preceding claim will allow absolutely instant start feature to the video recorder. Normally (in the 'Save' configuration) there is a few second lace up period during which time the tape stored inside the cassette is threaded around the recorder mechanism. During this time (and any additional time whilst the recording mechanism builds up to the correct speed), recording does not begin. However, if the length of stored data time exceeds the lace up time, then to all intents and purposes the recording will appear to have started even before the instant the record button is pressed.

8) **The Hindsight Device** as claimed in any preceding claim can reduce head and tape wear. Many video recording systems have a pause facility whereby the forward motion of the tape is stopped whilst the recorder is in pause mode. The tape remains laced up and the drum carrying the record heads continues to revolve. Whilst many video recorders have the facility to be left in this pause mode indefinitely, most manufacturers advise against doing so as wear will take place on one point of the tape. In addition wear is still taking place on the recorder heads. Using the **DSAV** (Digitally Stored Audio and Video) device this will allow the tape to be unlaced and re-laced and the recorder mechanism left in an inactivated state.

9) **The Hindsight Device** as claimed in any preceding claim can will enable pictures and sound to be recoverable from earlier time prior to the recorder being activated. In normal operating conditions that prevail (whether in the professional or amateur domain) a camera is powered up and switched on to view a scene prior to recording it. However in many cases the action suddenly starts before the camera operator anticipates or has time to switch the camera to record mode. If the camera is in 'save condition' it can take a further 2-3 seconds to lace up the camera prior to being able to record the information. Even in 'Standby Mode' slow reactions can loose valuable seconds of unrepeatable action. Even if the camera is a disc based recording machine the reaction time can still be half a second to press the Record Start button. More often than not action has already taken place and the camera operator and or director wishes that he could have started earlier. The **Hindsight** device will allow this wish to become a reality, not only for the 2-3 seconds lace up time but also the previous several seconds prior to the lace up time will be recorded as a lead into the action. (Ten seconds is a realistic amount of time missed but in fact it could be thirty seconds or even one minute if enough memory were supplied.

10) **The Hindsight Device** as claimed in any preceding claim, when the camera is switched out of record mode but when a further shot is required before the 10 second 'buffer' has been downloaded, then exactly the same conditions would apply - namely that the recorder would continue to receive information as it fell off the end of the 'buffer' and continue for 10 seconds after all recordings had stopped. (It would not be necessary to aim the camera at the subject after the decision had been taken to stop recording even though the recording was still downloading).

11) **The Hindsight Device** as claimed in any preceding claim would ideally be build into and incorporated within a video recording system, however it could also be an external device that allowed information to be fed into it (where it was stored and

delayed) and then onto the recording medium. If it was an optional extra then it would be desirable for the camera to be manufactured so as to enable this 'additional unit' to be plugged in between the camera/lens viewing device and the actual recording device. It may be that existing camcorders could be modified to incorporate the **Hindsight** device. The camcorder would have to have an outlet interface from the camera viewing side and have an inlet interface to the recording device. At all times the device is in use it operates in-between the camera/lens function and the recorder/recording mechanism. There would be no reason why the **Hindsight** device could not be either in use at all times or it could be switched out of the system.

12) **The Hindsight Device** as claimed in 1-11 can be a stand alone device. The Hindsight device does not need a separate recording outlet when the action can predictably take place within the time scan of its memory capacity. With a ten second 'buffer' that is constantly storing fresh information then all that is required to keep this information is that the device is switched off before the wanted information has been lost. The **Hindsight** device buffer can then be downloaded onto a tape or disc storage medium in the normal way at a later time. The advantages of this are practical and economic. In a predictable video recording location it is often desirable to have two or more cameras running at the time of the action. EG a car crash scene. Two such cameras with **Hindsight** buffers could be recording permanently along with the main video camera. A few seconds after the action has stopped the two extra cameras are switched off. Their image and sound information is then downloaded onto the main camera and they are ready to be used again. This saves having three of the more expensive recording machines and keeps the quality of recording consistently the same for all three.

13) **The Hindsight Device** as claimed in 1-12 would have sufficient memory to maintain the quality of the stored and retrieved data in the **Hindsight** device should be such that no loss of quality of the video or audio data is perceivable and ideally data transfer rates and data bandwidth should equal or better the specification of the original system. A professional camera such as a Sony DVW700P, which stores information at the rate of 125.58 M/bits/Sec, would require higher quality and more memory and processing than an amateur domestic VHS type camera.

14) **The Hindsight Device (with Time Shifter option)** as claimed in 1-13 would have a strobe control whereby it is possible to make a combination of the two :- elapsed time duration followed by an amount of frames that are recorded after each time period. I.e. 5 second interval after which 10 frames are put down and then repeated as long as necessary. (*See non linear effects)

15) **The Hindsight Device (with Time Shifter option)** as claimed in 1-14 would have Fill or Flow control. This selects whether the buffer fills up and holds its maximum memory waiting to be downloaded or whether it allows the information to flow out at the end as new information replaces it. In the case of a repetitive sequence and with constant monitoring, all that is required to happen is that the buffer be stopped at the required moment and depending upon the before and after control setting, the relevant information will be stored waiting to be down loaded.

16) **The Hindsight Device (with Time Shifter option)** as claimed in 1-15 would have A Before and After delay control. This allows for a before & after delay. When it is desirable to see cause and effect the ten second buffer (real time in playback) can be split into two parts depending upon what part of the action is required to record. NB There will be an overlap range which is not possible to select i.e. a slow shutter speed with a short elapsed time frame which amounts to a longer exposure than the frequency of time between frames. The software programme will not allow this to be selected.

17) **The Hindsight Device (with Time Shifter option)** as claimed in 1-16 has a buffer memory which stores individual frames at pre-set intervals. Once the buffer approaches its full capacity, the recording device is programmed to make a back space edit then go into its record mode and the buffer is downloaded onto the tape or larger hard disc recording format. This leaves the buffer free to store more individual frames.

18) **The Hindsight Device (with Time Shifter option)** as claimed in 1-17 can store any number of individual frames which are collected and downloaded onto tape which typically would be 30-40 minutes of real time duration on a current professional recording device or 60 - 240 minutes for a current domestic VHS recorder. Either way the real replay time far exceeds the requirements of any practical usage for which the time lapse period covers. In other words the Time Shifter option can cover periods of time ranging from seconds to many months or even years.

19) **The Hindsight Device (with Time Shifter option)** as claimed in 1-18 can have an exposure interval between frames which can be as long as the interval between frames minus one 24th. of a second. In other words a time lapse that recorded one frame per second could have an exposure of 24/25 Th. of a second which could be desirable for low light usage as the actual exposure period could be up to 24/25ths of a second. On the other hand a far higher shutter speed (such as 1/500 or 1/2000 Th. sec) could also be selected with the intention of making separate but fast moving images sharper. Similarly an elapsed duration of 10 seconds between frames could allow an exposure time of almost 10 seconds long.

20) **The Hindsight Device (with Time Shifter option)** as claimed in 1-19 can have software with which to operate this buffer that can be programmed to allow each frame to be outputted several times (*see controls). This would give the impression of time lapse but allowing each individual picture to be seen for a selected elapsed time period. In other words a time lapse sequence of one second duration (which is speeding up real time images by 25 times) could be replayed and downloaded as say five consecutive picture images. This would give the impression of strobed time lapse without any additional editing. Any permutation of repetitive frames could be programmed from this buffer.

21) **The Hindsight Device** as claimed in 1-17 can be used as a Surveillance camera. Typically Surveillance cameras take single frames or bursts of frames at intervals

and these are stored onto a low quality recording medium. If the **Hindsight** device were utilised then the lead up to the moment of required surveillance could be stored and downloaded in the same way as described previously. Real time images rather than time lapsed would be more useful in identifying a crime. The only difference being that some form of triggering mechanism such as a broken beam, an emergency switch, a trembler device or sound activated switch must be operated to save the previously stored images.

22) **The Hindsight Device** as claimed in 1can be used as a car security camera. With a **Hindsight** device incorporated within a car, each new driver would be recorded and stored for a few seconds after which time the 'buffer' would run continuously. If the driver was unauthorised then his image would be retrievable once the car was recovered. Perhaps the most important use would be in the event of a crash. The **Hindsight** device, running continuously, would be de-activated in the event of one of the cars sensors detecting a crash and stop immediately. The device would be built into an inaccessible part of the vehicle that was fireproof and tamperproof. The recording would legally belong to the owner of the car and could be presented in evidence on his behalf in any analysis of the accident.

23) **The Hindsight Device** as claimed in 1can be used with electronic stills Cameras. The same principal would apply to stills cameras as moving image cameras. Once the camera is switched on and the **Hindsight** device activated then images at a pre determined rate are being constantly stored into the memory. Until the camera shutter control is activated the information is lost after say 10 seconds. However as a still photo requires higher quality than a video frame, then more memory would be required. However if a frame rate of say 3 pictures per second were selected, then this would make the memory more desirable in size and economics. Once images were stored they should be reviewed and only ones capturing the required action need to be kept, thus releasing the rest of the memory for future use. For still photographs this 3 second frame rate would be very desirable as most motor drives operate at about this speed. If a higher rate was required (say 5 frames per second) then this could be selected but less elapsed time would be available as stored pictures in memory. I.e. the window of information would be less, the more images were stored for a given memory capacity.

24) **The Hindsight Device** as claimed in 16 would have variable still frame rates.
For a given memory capacity there would be a number of photographs stored at a given file size. Let us say this is 15 images to be held in temporary memory.

Frames per second	Elapsed time covered (in seconds)
1	15
3	5
5	3
10	1.5
15	1

The Patent Office

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Application No: GB 9725832.1 **Examiner:** John Coules
Claims searched: 1-24 **Date of search:** 7 April 1998

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.P): H4F FAAE,FAAX,FCK,FKX,FKA

Int Cl (Ed.6): H04N 5/77,5/907,7/18; G08B 13/196

Other:

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
X	GB 2295065 A	(Mitsubishi) see particularly abstract and desciption starting on page 14 line 6	1 at least
X	GB 2231753 A	(Golden River) see particularly page 6 line 3 to page 7 line 8, and claim 7	1 at least
X	US 5402167	(Cornell Research) see time delay memory network 19	1 at least
X	US 4897732	(Canon) see frame memory 7 in figures 4,6 and 8, column 2 line 54, column 5 line 55.	1 at least

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.